

2.1 BOILERS, STEAM GENERATORS & PROCESS HEATERS

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February 3, 2010

Process Description

This chapter is limited to external combustion equipment; such as boilers, steam generators, and process heaters; firing the commonly used conventional fuels such as natural gas, refinery gas, liquefied petroleum gas, landfill gas, distillate oil, residual oil, etc. Waste fuel combustion sources burning such fuels as municipal waste or refuse-derived fuel will require more detailed analysis and are not covered by this chapter. Boilers covered range from commercial (< 10 MMBTU/hr), small industrial (10 – 100 MMBTU/hr), to large industrial (100 – 250 MMBTU/hr), and utility boilers, generally rated above 250 MMBTU/hr. External combustion is when the combustion process heats a separate fluid, such as water or steam, which in turn is used.

Thorough explanations of the combustion of conventional fuels are available from [AP-42 \(Fifth Edition, Volume I\)](#):

Fuel Oil	Chapter 1.3, Fuel Oil Combustion
Natural Gas	Chapter 1.4, Natural Gas Combustion
LPG	Chapter 1.5, Liquefied Petroleum Gas Combustion
Wood	Chapter 1.6, Wood Residue Combustion in Boilers

Any boiler, steam generators, and process heaters or similar combustion equipment; which burns exclusively natural gas, LPG, or combination and has a maximum firing rate of 10 million BTU per hour or greater, or which burns other fuels and has a maximum firing rate of 1 million BTU per hour or greater; is subject to permitting requirements per [Regulation 2-1-114.1](#).

In general, natural gas is the most common fuel used. Fuel oil may be used as a back up fuel in the event of natural gas curtailment. Because the [BACT](#) requirements for wood combustion typically require add-on abatement equipment, wood combustion in new/modified combustion equipment is uncommon.

Completeness Determination

The following District forms should be completed and fees provided for the boilers. Use the [Completeness Determination Checklist](#) to verify completeness. Use the [Data Form Guidance](#) to ensure that the forms are completed correctly. Use the [Fee Calculation Guidance](#) to ensure that the fees are calculated accurately.

1. [Form 101-B](#) (one for facility).
2. [Form C](#) (one per source).
3. If combustion products exhaust into add-on abatement device, [Form A](#) (one per device).
4. If Health Risk Screening is triggered, [Form HRSA](#) (one per source).
5. Fees, calculated per [Regulation 3 \(Schedule B\)](#).

Emission Calculations

The ideal hydrocarbon products of combustion in which a fossil fuel is burned are water vapor and carbon dioxide. All other products are considered pollutants, consisting mainly of NO_x (Nitrogen Oxides), CO (Carbon Monoxide), POC (Precursor Organic Compounds in the form of unburned hydrocarbons), SO_x (Sulfur Dioxide), and PM₁₀ (Particulate Matter).

Emission factors of criteria pollutants from external combustion of common fuels can be found in [AP-42 \(Fifth Edition, Volume I\)](#):

Fuel Oil	Chapter 1.3, Fuel Oil Combustion
Natural Gas	Chapter 1.4, Natural Gas Combustion
LPG	Chapter 1.5, Liquefied Petroleum Gas Combustion

Per [District policy](#), when site specific or source category specific emission factors are not available, the following emission factors shall be used to calculate TAC emissions from miscellaneous natural gas combustion sources:

TAC Emission Factors for Miscellaneous Natural Gas Combustion		
TAC	Emission Factor (lb/MSCF)*	Emission Factor (lbs/therms)*
Benzene	2.1E-6	2.06E-7
Formaldehyde	7.5E-5	7.35E-6
Toluene	3.4E-6	3.33E-7

* based on 1020 BTU/SCF

Other fuels may use source test data from comparable equipment of similar design and configuration to estimate emissions. However, the permit conditions for these alternative fuel combustion sources should include start-up source testing requirements to validate the emission factors used.

In general, a new combustion source with a firing rate of 10 million BTU/hr or more will trigger BACT requirements. As a result, the BACT emission limits or the manufacturer's guaranteed NOx and CO emission rates, if they are lower than the BACT emission limits, should be used to calculate emissions. The permit conditions for these sources should include start-up source testing requirements to validate the emission factors used. The BACT emission limits for CO, NOx, and POC in flue gases are usually specified in parts per million (ppm) by volume corrected to 3% oxygen. Since the measurements are not always made under the same operating conditions, the measurements are often corrected to a standard operating point of 3% excess oxygen for comparison to the BACT and Regulation 9-7 limits. The equation for making this correction is:

$$\text{ppm (3\%)} = \text{ppm}_{\text{measured}} * [(21-3)/(21-\%O_{2 \text{ measured}})]$$

To convert "ppm" to "lb/MMBTU":

$$\text{lb/MMBTU} = \text{ppm}_{\text{measured}} * [(21-0)/(21-\%O_{2 \text{ measured}})] * (\text{MW}) * F_d / V_M$$

where:

V_M = molar volume = 359 dscf/mole = 385.3 scf/mole (corrected to 68°F from 32°F)

MW = molecular weight of pollutant (i.e., 46.01 lb NO₂/mole or 28.0 lb CO/mole)

F_d = 8,710 dscf/MMBTU

This conversion may be done using the EPA " F_d " factor from 40 CFR Part 60 test methods, for example Method 19, Table 19-1-F. " F_d " is the ratio of the volume of dry flue gas to the heat value of the fuel used to produce the flue gas. F_d for natural gas is 8,710 dscf/MM BTU (from Method 19). The conversion assumes that the flue gas is ideal (since flue gas molar volume is assumed to be 359 cf/lbmole), which is a valid assumption because of the relatively high temperature and low pressure of the flue gas. The conversion includes a correction of the pollutant concentrations from the percent of oxygen (O₂) measured to 0% O₂ (in accordance with District procedure ST-13A) since the flue gas volume assumes stoichiometric combustion (zero excess air and O₂). Additional F_d factors can be obtained from Table 19-2 of [Method 19](#).

Applicable Requirements

District Rules and Regulations

Boilers, steam generators, and process heaters are subject to the requirements of [Regulation 9-7](#). In general, if a combustion source meets its BACT requirements, it will always meet its applicable [Regulation 9-7](#) standards. If a Boiler, steam generator, or process heater has a maximum firing rate 250 MMBTU/hr and above, then it is also subject to [Regulation 9-3](#) and [Regulation 9-11](#). Again, if a combustion source meets its BACT requirements, it will also always meet its applicable [Regulation 9-3](#) and [Regulation 9-11](#) standards.

New Source Performance Standards (NSPS)

A boiler may be subject to the [NSPS](#), if it is used as steam generating unit for which construction, modification, or reconstruction is commenced after June 9, 1989 and it has a maximum design heat input capacity of 29 megawatts (MW) (100 million Btu per hour (Btu/hr)) or less, but greater than or equal to 2.9 MW (10 million Btu/hr). The permit engineer should review the proposed boiler application to ensure that the proposed boiler is either exempt from the NSPS or complies with the NSPS.

Best Available Control Technology (BACT)

BACT for Boilers, Steam Generators, and Process Heaters firing commonly used fuels is specified in the [BACT/TBACT Workbook](#). The following are the applicable BACT requirements for:

Boilers, Commercial, Industrial, Institutional

- [Boiler, Rental: On-site < 6 consecutive months](#)
- [Boiler: 5 to <33.5 MMBtu/hr](#)
- [Boiler: ≥33.5 to <50 MMBtu/hr](#)
- [Boiler: ≥50 MMBtu/hr](#)
- [Boiler, CO - Refinery](#)
- [Boiler or Water Heater - Landfill or Digester Gas Fired](#)
- [Boiler - Municipal Refuse Fired](#)
- [Boiler - Wood Fired](#)

Process Heaters

- [Heater - Refinery Process, Natural or induced Draft, <50 MMBtu/hr](#)
- [Heater - Refinery Process, Forced Draft, <50 MMBtu/hr](#)
- [Heater - Refinery Process, >50 MMBtu/hr](#)

Inform the [BACT Coordinator](#) of updates to the BACT/TBACT Workbook.

California Environmental Quality Act (CEQA)

Permit applications which are reviewed following the specific procedures, fixed standards and objective measurements set forth in this chapter (2.1) are classified as ministerial and will accordingly be exempt from CEQA review per [Regulation 2-1-311](#).

In addition to the above-mentioned source-specific applicable requirements, other requirements may also be applicable depending on the facility, its application emissions, and its source location:

- | | |
|--|--|
| <input type="checkbox"/> Offsets | <input type="checkbox"/> School Notification |
| <input type="checkbox"/> Prevention of Significant Deterioration | <input type="checkbox"/> Risk Screening Analysis |

Permit Conditions

Standardized conditions for boilers are available from the [Permit Condition Guidance](#). Refer to the [Evaluation Report Template Guidance](#) to obtain the Microsoft Word formatted permit conditions for this source category.